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EFFECT OF DIFFERENT MULCHES ON THE GROWTH AND YIELD OF LATE PLANTED GARLIC (*ALLIUM SATIVUM* L.)

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The use of water-hyacinth root, rice straw and dried grass as mulches was evaluated for their effects on the growth and yield of late planted garlic at Bangladesh Agricultural University farm during 1990-91 growing season. Plants treated with any kind of mulches under study significantly increased plant height, number of leaves per plant, length of leaf, length of pseudostem, number of roots per plant, bulb and neck diameter over the control. These mulches significantly influenced both on chlorophyll-a and chlorophyll-b contents. Bulb length, bulb diameter, clove length, clove diameter, clove number per bulb, 100 clove weight and yield were also significantly higher in plants treated with mulches. All mulches provided weed control as well. Among the treatments, water-hyacinth root was proved to be superior as mulching material in producing garlic. All types of mulches in this study highly compensated the reduction of yield of garlic due to late planting.

Key words: Garlic, Mulches, Growth.

Introduction

Garlic is cultivated in Bangladesh during the winter season when there is low precipitation and high evapotranspiration. The optimum time of planting for garlic in Bangladesh is the beginning of the dry season, i.e. early to mid-Nov. If garlic is planted after 20 Nov. in Bangladesh, yields are reduced to nearly half than those obtained from garlic planted at the optimum time. The probable cause behind the yield reduction is due to the reduction of soil moisture during the early stages of plant growth. Crop cultivation during this period requires supplemental irrigation. Irrigation facilities are often unavailable in Bangladesh. Mulches help in retaining moisture in the soil.

Mulches reduce the quantity of energy consumed in evaporation by blocking the transport of vapour [1]. Paper, straw, weed or trash mulches create an insulating layer on the soil surface thus conserving moisture and reducing soil temperature [2]. Water-hyacinth increases surface temperature but transmits little radiation downward thereby maintaining a cooler surface [2]. Rice straw mulch also increases water potential and decreases soil temperature [3]. Works on the effect of various natural and artificial mulches were reported [1,2]. Mulching increases growth and yield of potato [4], cabbage [5] tomato [6], ginger [7], okra [8], and brinjal [9] by conserving soil moisture during dry season. Mulching suppresses weed growth of onion and thus increases yield [10].

Information is lacking about the effect of mulches on the growth and yield of garlic planted late in Bangladesh. The present work was, therefore, undertaken to study the effect of some natural mulches on the growth and yield of late planted garlic.

Materials and Methods

The experiment was carried out at the Bangladesh Agricultural University farm from Dec. 4, 1990 to May 6, 1991 with a cultivar of garlic locally grown in Bangladesh. Four treatments such as (i) without mulch, i.e. control (T_0); (ii) rice straw as mulching material (T_1); (iii) water-hyacinth root as mulching material (T_2); and (iv) dried bermuda grass as mulching material (T_3) were selected. Rice straw @ 2.0 ton/ha, water-hyacinth @ 3.5 ton/ha and dried grass @ 2.0 ton/ha, respectively were used following Rashid *et al.* [4]. The experimental plots were laid out in the randomized complete block design with five replications. The soil was sandy loam having 1.3% organic matter with pH 6.0. The unit plots were 3 X 3m in size in which cloves were planted at a spacing of 20 X 10 cm on Dec. 4, 1990 following standard cultural practices. Cowdung and triple superphosphate were applied @ 10 ton/ha and 148 Kg/ha, respectively as basal doses during land preparation. Urea and muriate of potash @ 173 Kg/ha and 148 kg/ha, respectively were applied at 20 and 40 days after planting (DAP) as top dressing in two equal installments. Mulch materials, 10 to 15cm thick were put on plots after 20 DAP. Mulched plots were weeded only 2 times and the control plots weeded 5 times. Observations on growth parameters were made at four different stages of growth. Plant from each harvested area ($1m^2$) were uprooted carefully and brought to the laboratory for evaluation. Data were recorded on plant height, leaf number, length of leaf, length of pseudostem, root number/bulb, bulb as well as neck diameter at 42 DAP, 70 DAP, 98 DAP and 126 DAP, respectively. Leaf pigments were estimated following Yoshida *et al.* [11] at 70 DAP.The bulb length, bulb diameter, clove length clove

diametere, clove number per bulb, 100 clove weight and yield were recorded after final harvest. The variances of each parameters were statistically analysed and the treatment means were compared by Duncan's new multiple range test (DMRT).

Results and Discussions

The effects of different mulches at various stages of growth of late planted garlic are shown in Table 1. Significant variations in plant height number of leaves/plant, length of leaf, length of pseudostem, root number/plant, bulb and neck diameter were found among the treatments, especially at the later stages of growth.

The plant heights were significantly different from control at all the stages of plant growth. Plants treated with rice straw, water-hyacinth root and dried grass mulches at 42 DAP gave statistically similar heights(Table 1). Water-hyacinth root mulch produced the significantly tallest plants at 70, 98 and 126 DAP, respectively. Plant heights obtained with the treatments of rice straw and dried grass mulches were statistically similar at all the stages of plant growth. The shortest plants were produced where no mulch was used.

Number of leaves per plant at 42 DAP was not influenced by any mulch treatment (Table 1). Plants treated with mulches produced significantly different number of leaves from control at the later stages of growth (Table 1). Plants treated with water-hyacinth root mulch produced the highest number of leaves per plant at 70, 98 and 126 DAP, respectively which was followed by the plants treated with rice straw and dried grass mulches. The number of leaves per plant obtained with the rice straw and dried grass mulches was statistically similar (Table 1).

The leaf lengths in all the treatments at various stages of growth were significantly different from control (Table 1). The water-hyacinth root mulch produced higher leaf lengths than other treatments at 42 DAP. Plants treated with rice straw as well as dried grass mulches and control plants produced leaves of similar lengths at 42 and 70 DAP, respectively (Table 1). Leaf lengths were statistically similar for all the mulch treated plants at 98 and 126 DAP, respectively.

Length of pseudostem in all the treatments was similar and insignificant at 42 DAP (Table 1). Water-hyacinth root mulch produced the longest pseudostem at 70, 98 and 126 DAP, respectively (Table 1). Plants treated with rice straw and dried grass mulches produced similar pseudostem lengths. But the pseudostem lengths produced with control plants were statistically similar to those produced with rice straw and dried grass mulches at 70 DAP (Table 1).

The number of roots per plant was the same and in significant at 42 DAP in all the treatments (Table 1). However, Water hyacinth root mulch produced higher numbers of roots at 70 DAP which was followed by plants treated rice straw,

TABLE 1. EFFECT OF DIFFERENT MULCHES ON GROWTH PARAMETERS OF LATE PLANTED GARLIC AT VARIOUS STAGES OF PLANT GROWTH.

Days after planting (DAP)	Treatments	Growth parameters of garlic						
		Plant height (cm)	Leaf number/ plant	Average leaf length (cm)	Pseudo-stem length (cm)	Root number/ plant	Bulb diameter (cm)	Neck diameter (cm)
42	T_0	23.51b	4.5ONS	20.3b	4.4 NS	13.0 NS	-	-
	T_1	25.1 a	4.6 NS	20.7b	5.2 NS	13.1 NS	-	-
	T_2	27.3 a	4.6 NS	23.4a	5.4 NS	13.3 NS	-	-
	T_3	25.6 a	4.4 NS	21.5b	5.3 NS	13.1 NS	-	-
70	T_0	41.1 c	5.2 c	33.3b	9.6 b	42.8 C	1.46c	0.68c
	T_1	50.9 b	5.3 b	35.8ab	10.6ab	45.1 b	1.60b	0.80b
	T_2	54.9 a	5.6 a	38.1a	11.8a	49.8 a	1.70a	0.85a
	T_3	51.0 b	5.3 b	35.7ab	10.4ab	44.5 b	1.59b	0.78b
98	T_0	52.2 c	6.5 c	31.3b	22.2c	68.7 b	3.1 c	0.71c
	T_1	62.1 b	7.3 b	37.2a	25.5b	97.5 a	3.5 b	0.82b
	T_2	64.8 a	7.7 a	38.8a	27.1a	100.6a	3.8 a	0.88a
	T_3	62.0 b	7.3 b	37.3a	24.4b	98.2 a	3.4 b	0.81b
126	T_0	57.2 c	6.6 c	35.7b	23.3c	69.7 b	3.26 c	0.70c
	T_1	64.6 b	7.4 b	38.2a	26.4b	101.6a	3.64 b	0.81b
	T_2	68.4 a	7.7 a	39.7a	28.1a	105.2a	3.87 a	0.87a
	T_3	63.9 a	7.4 b	37.8a	26.3b	102.5a	3.61 b	0.80b

Mean values bearing the same letter in the same column do not differ significantly at 5% level by DMRT. (T_0=Control; T_1=Rice straw,T_2-Waterhyacinth root and T_3=Dried grass mulches, respectively).

dried grass mulches and control plants, respectively (Table 1). The number of roots produced by rice straw and dried grass mulches was similar at 70 DAP. All the mulches produced statistically similar root numbers at 98 and 126 DAP (Table 1).

The diameters of bulbs and necks produced by different treatments were significant in regard to control. Plants treated with water-hyacinth mulch gave the largest bulbs and neck diameters which was followed by the plants treated with rice straw and grass mulches (Table 1). Bulb and neck diameters obtained from the treatments of rice straw and grass mulches was statistically similar (Table 1). The lowest bulb and neck diameters were obtained in control (Table 1).

Plant height, leaf number, length of leaf, length of pseudostem, number of root, bulb and neck diameter, etc. have little genetic variability in a species, but are regulared by microenvironmental variables. Thus, the variability obtained in the above parameters was the effect of modified microclimatic conditions of soil favourable for plant growth imposed by different mulches.

Use of different mulch materials resulted in different levels of leaf chlorophyll content is shown in Table 2. Mulches produced higher leaf pigments compared to control plants. The highest levels of Chlorophyll-a, chlorophyll-b and total chlorophyll were obtained in plants treated with water-hyacinth root mulch, whilst the lowest amount was in control plants. Rice straw and grass mulches produced similar amount of pigments (Tables 2). The better performance of water-hyacinth in producing leaf pigments may be due to better conservation of soil moisture as in potato [12].

The effects of the different mulches on yield components and yields of late planted garlic is presented in Table 3. The size of the bulbs obtained by various mulching treatments was significantly larger than those of control plants (Table 3). The largest bulb size (length 3.21cm and diameter 3.77cm) was obtained in the plants where water-hyacinth was used as mulches. Plants treated with rice straw and dried grass mulches gave similar sizes of bulbs (Table 3) while the shortest bulb sizes were in control plants. The size of cloves was also significant and the largest size of cloves (length 2.41cm and diameter 0.73cm) was obtained in plants treated with water-hyacinth root as mulch (Table 3). Clove sizes produced by rice straw and dried grass mulches were statistically similar. Control plants produced the shortest cloves (Table 3).

The number of cloves per bulb of garlic was significant in regard to control. Plants treated with water-hyacinth root as mulch produced the highest number of cloves per bulbs which was followed by plants treated with rice straw and dried grass mulches (Table 3). Control plants gave the lowest number of cloves per bulb.

The weights of per 100 cloves resulting from different treatments were also significant in regard to control. Plants treated with water-hyacinth mulch showed the best performance in producing weight of 100 cloves (Table 3). Plants treated with rice straw and dried grass mulches gave similar weights of per 100 cloves. The control plants showed the poor performance for 100 clove weight (Table 3).

Yield obtained by different mulches was also significant in regard to control (Table 3). Plants treated with water-hyacinth root as mulches produced the highest yields (5.12 ton/ha) which was followed by rice straw (4.11 ton/ha) and dried grass (4.08 ton/ha) mulches (Table 3). The yields obtained by rice straw and dried grass mulches were statistically similar. Control plants produced the lowest yield (2.64 ton/ha).

The effect of different mulches on the growth of weeds in control and mulched plots of garlic during the cropping season is presented in Table 4. It was found that nine kinds of winter weeds grew in the garlic plots where mulch was not used and the weeds were densely populated. Only two types of weeds were found in mulched plots and their populations were light (Table 4). The control plots were weeded five times within the growing season whereas the mulched plots required only two to make them weed free. The surface

TABLE 2. EFFECT OF DIFFERENT MULCHES ON CHLOROPHYLL CONTENT OF LEAF GARLIC.

Treatments	Chlorophyll content, mg/g fresh wt. of leaf at 70 DAP		
	Chloro.-a	Chloro.-b	Total chlorophyll
T_0	1.174 a	1.146 c	2.320 c
T_1	1.216 b	1.185 b	2.401 b
T_2	1.412 a	1.260 a	2.672 a
T_3	1.209 b	1.178 b	2.387 b

Mean values bearing the same letter in the same column do not differ significantly at 5% level by DMRT. (T_0 = Control; T_1 = Rice straw, T_2 = Water-hyacinth root and T_3 = Dried grass mulches, respectively)

TABLE 3. EFFECT OF DIFFERENT MULCHES ON YIELD COMPONENTS AND YIELD OF LATE PLANTED GARLIC

Treat-MENTS	Yield contributing characters and yield						
	Bulb size (cm)		Clove size (cm)		Clove number/ bulb	100 Clove weight (g)	Yield ton/ha
	Length	Diameter	Length	Diameter			
T_0	2.57c	3.19c	2.01c	0.51c	14.56c	51.82c	2.64c
T_1	2.97b	3.58b	2.29b	0.68b	16.90b	63.71b	4.11b
T_2	3.21a	3.77a	2.41a	0.73a	20.06a	71.16a	5.12a
T_3	2.92b	3.55b	2.28b	0.68b	16.64b	62.92b	4.08b

Mean values bearing the same letter in the same column do not differ significantly at 5% level by DMRT. (T_0 = Control; T_1 = Rice straw, T_2 = water hyacinth root, T_3 = Dried grass mulches, respectively)

of the soil was covered by mulching materials and it suppressed the growth of weeds and increased yield as reported for brinjal [9] and onion [10].

All mulches studied maintained proper soil moisture and temperature favourable for plant growth, suppressed the growth of weeds, and increased yields of late planted garlic. It is clear from the study that all the mulches had positive effects on growth and yields and thus mulches are recommended in garlic cultivation. The use of water-hyacinth as mulch was found better compared to others.

TABLE 4. LIST OF WEEDS FOUND IN CONTROL AND MULCHED PLOTS OF GARLIC DURING THE CROPPING SEASON.

Name of weeds	Garlic plots mulched with			
	Control (T_0)	Rice straw (T_1)	W.hyacinth (T_2)	Grass (T_3)
1. Bermuda grass (*Cynodon dactylon*)	+	+	+	+
2. Nakphuli (*Cyperus michelinanus*)	+	-	-	-
3. Common sedge (*Cyperus rotundus*)	+	+	+	+
4. Vetch (*Vicia sativa*)	+	-	-	-
5. Spiny amaranth (*Amaranthus spinosus*)	+	-	-	-
6. Bathua (*Chenopodium album*)	+	-	-	-
7. Nunia (*Portulaca oleraceae*)	+	-	-	-
8. Crab grass (*Eleusine indica*)	+	-	-	-
9. Carpet weed (*Mullugo verticillata*)	+	-	-	-

"+" means weed present and "-" means weed absent.

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